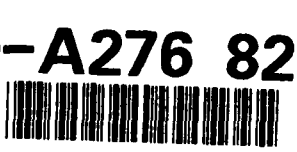

1993
Executive Research Project
S3

Dual Use Technology: Status, Issues, and Change

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Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY N/A	3. DISTRIBUTION/AVAILABILITY OF REPORT Distribution Statement A: Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NDU-ICAF-93-83	5. MONITORING ORGANIZATION REPORT NUMBER(S) Same
6a. NAME OF PERFORMING ORGANIZATION Industrial College of the Armed Forces 6b. OFFICE SYMBOL (If applicable) ICAF-FAP	7a. NAME OF MONITORING ORGANIZATION National Defense University
6c. ADDRESS (City, State, and ZIP Code) Fort Lesley J. McNair Washington, D.C. 20319-6000	7b. ADDRESS (City, State, and ZIP Code) Fort Lesley J. McNair Washington, D.C. 20319-6000
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification) Dual Use Technology: Status, Issues, and Change

12. PERSONAL AUTHOR(S) Roxanne Bailey

13a. TYPE OF REPORT Research	13b. TIME COVERED FROM Aug 92 TO Apr 93	14. DATE OF REPORT (Year, Month, Day) April 1993	15. PAGE COUNT 34

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

SEE ATTACHED

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Judy Clark	22b. TELEPHONE (Include Area Code) (202) 475-1889 22c. OFFICE SYMBOL ICAF-FAP

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

ABSTRACT

Evaluates the status, issues, and recent changes in dual-use technology, processes, and equipment for satisfying DoD requirements while supporting the commercial industrial base. Identifies concerns for DoD consideration when formulating policy and implementing changes in the law. Identifies opportunities for leveraging DoD dollars in declining budget environment. Identifies barriers to full realization of the opportunities.

Dual-Use Technology: Status, Issues, and Change

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DUAL-USE TECHNOLOGY: STATUS, ISSUES, AND CHANGE

I. Problem Definition

Introduction and Background

In a world where declining defense budgets place stress on military modernization efforts and on American defense industry viability, when the global competitiveness of the overall industry is simultaneously perceived to be declining, many in the community are seeking solutions. Numerous approaches are under consideration, ranging from outright subsidies to doing nothing and letting the market fix it. One approach offering some promise is called "dual-use technology." Numerous terms are in use, all trying to capture the idea. The term "dual-use technology" is itself used to describe many ideas, some of which clearly belong in other categories. Furthermore, "dual-use" clearly applies to more than technology -- it can and does apply to existing components, processes, and systems. Spinoff and spinon describe a subset of dual use. Computers, semiconductors, jet engines, and aircraft all owe their commercial viability to the investment of federal research and development (R&D) dollars at the beginning. Now the federal government benefits from the existing, commercialized version of technologies it helped to create -- or at least, it could benefit, if the barriers to using commercial technology are overcome. This illustrates spinoff and spinon -- both elements of dual-use. Technology transfer, which also carries the less favorable connotation of foreign disclosure, is another oft-used term.

All of these terms are attempts to describe a process in which an investment made by

one entity in the advancement of technology is exploited by another in a different environment, and for a different purpose. Classically, the paradigm described investment by the US military establishment (the "Pentagon," oversimplified) in the pursuit of high risk technological development -- even breakthroughs -- and the subsequent, incidental, use by US firms of the techniques and knowledge that resulted to develop and bring to market commercial products or processes.

A recent book, *Beyond Spinoff,* published by the Harvard Business School Press, prefers the term "dual-use" technology, and defines it as "technology that has both military and commercial applications." This definition opens the process to transfer of technology from the commercial side to the military side. The potential for flow of technology in **both** directions is important, because through the commercial-to-military flow, the DoD could conceivably benefit just as the commercial industry benefits from the military-to-commercial flow. Leverage of scarce R&D dollars is a definite good in today's environment. This definition leaves open the question of timing. Either side may develop the technology first; or, they may develop it together, through cooperative or complementary efforts.

So What's the Problem?

The topic is hot today. Studies overlap one another, generally ending with recommendations which, if adopted, the authors expect will surely solve the entire problem, making defense cheap, US industry highly competitive, and the US economy revitalized. Congress has seized on the ideas of dual-use technology, defense conversion, and cooperative research and development as things it can direct and foster through fiscal set-asides. Over

the last several years, it has passed several laws to force DoD to foster the transfer of technology to commercial use, in pursuit of greater global competitiveness of US firms. Like it or not, DoD as well as the rest of the Federal government will be pursuing these ideas.

Therefore, the question before us is no longer whether it's a good idea to foster the transfer of technology between military and commercial use; the Congress has decided that one for us. Given, then, that DoD (and the other agencies) *will* directly support the transfer of technology, and invest in technologies with dual use potential, might there be something in it for the beleaguered DoD R&D program? Are there aspects about which DoD should have concern, or at least be cautious? The critical question, then, and the question at the center of this research, is

What are the benefits and concerns the DoD should consider as it prepares to foster the transfer and/or codevelopment of technology designed for military use or for commercial use?

Objectives of the Research

The objectives of this research are, through review of current literature and discussion with DoD policy-makers, to identify issues and concerns for DoD consideration in implementing the letter and intent of recent legislation.

What Methods Support These Objectives?

A literature search was conducted to sample the most current publications on the subject. Although an exhaustive search was initially contemplated, the subject has been and is receiving so much attention that the volume of relevant material is unwieldy. New

reports, books, and scholarly articles appear every week. Therefore, I chose to limit the literature search by time, quality, importance, and general acceptance in the technology community. Laws passed by Congress automatically made the cut, as did major studies commissioned by them. Anything published before 1989 (other than statute) was not included, on the theory that if it was important and recognized as well-done, it would be quoted and incorporated into more recent literature. Some spotchecks supported that theory. The remaining studies, books, and articles were recommended to me, or approved of by people I interviewed in the technology community. In addition, descriptions and results of the technology transfer process long employed by the Strategic Defense Initiative Office (SDIO) were used.

In addition to the literature search and analysis, I interviewed several individuals at the policy making level in the Air Force secretariat and Headquarters Air Force Materiel Command, as well as at the Defense Advanced Research Projects Agency (DARPA). Finally, the Industrial College of the Armed Forces (ICAF) curriculum and symposia sponsored here have provided access to speakers who addressed the subject.

Overview of the Study

The study begins with an operational definition of the term "dual-use" for the purposes of this study. Next is presented a review of the relevant legislation passed since 1980. A review of the most substantial literature in current use and with focus on this subject follows. The barriers to effective dual-use are then discussed, followed by presentation of some examples of success stories of recent years. From the success stories, some not-so-successful stories, and the literature reviewed come the conclusions about the current

issues that need to be addressed by DoD as it implements the legislation. Finally, some recommendations for consideration are presented.

II. Discussion and Findings

Multiple definitions and terms for the process exist. So, the first item to tackle is to develop an operational definition of dual-use technology, and dual-use technology policy. *Beyond Spinoff*, a book published in late 1992 by the John F. Kennedy School of Business, defines dual-use technology as "technology that has both military and commercial applications."[1] Spinoff, as viewed by the government, is generally considered to be free and with no or little government effort required. In this view, technology is developed specifically for some government use (defense, NASA, DoE), and as the commercial world learned of it, they would conceive of and pursue commercial product potential on their own. The spinoff concept or definition implies substantially less involvement and funding by the federal government than dual-use technology does. As it turns out historically, little transfer takes place without substantial human involvement. The classic spinoff concept is flawed.

In the National Competitiveness Technology Transfer Act of 1989,[2] the Congress employed the term "technology transfer," and defined it as the transfer of federally owned or originated technology to state and local governments and to the private sector. This approach assumes the technology has already been developed by government funding, and the knowledge, knowhow, and relevant artifacts are available for use by the commercial sector. In 1990, the Air Force implemented the law in its AF Regulation 80-27, and expanded the definition of technology transfer to refer to

> ... oral or written information or data; hardware; personnel, services, facilities, equipment; or other resources relating to scientific or technological developments of an Air Force RDT&E activity, provided or disclosed by any means to another federal agency; a state or local government; an industrial organization, including corporations partnership, limited partnership, or industrial development organization; public or private foundation; nonprofit organization, including a university; or other person to enhance or promote technological or industrial innovation for a commercial or public purpose.[3]

In 1992, however, the Congress began to use the dual-use terminology, in the Defense Conversion, Reinvestment, and Transition Assistance Act of 1992. In Title 10, Section 2491, they defined it: "The term 'dual-use' with respect to products, services, standards, processes, or acquisition practices, means products, services, standards, processes, or acquisition practices, respectively, that are capable of meeting requirements for military and non-military application."[4]

The term dual-use seems to have a meaning that is both specific -- "capable of meeting requirements for military and non-military application"-- and broad enough to encompass both the other terms and programs now in use, and the "products, services, standards, processes, or acquisition practices" (as described above) that we might wish to include. Jacques Gansler, in a presentation to a public symposium at ICAF, employed three terms:

* Dual-use R&D (satisfying both military and civil requirements),
* Dual-use operations (common labor and facilities for engineering, production and support -- of differing civil and military products), and
* Dual-use equipment (commercial, ruggedized equipment -- especially subsystems, parts, materials, and software).[5]

Therefore, throughout this paper the term "dual-use" will be used to refer to the entire set of approaches to technology, operations, and equipment that attempt to provide benefit to both government and commercial sectors. Although the orientation of this paper keeps the

discussion largely to military aspects of government, the term is also valid for describing any non-military requirements by DoD or other Federal agencies -- and some examples will show that wider use.

What the Literature Says

An enormous body of literature has been published on this subject, and more is published every day. Employing the federal dollars spent on public R&D to enhance the overall economy and competitiveness of American industry has taken center stage in today's political environment. The Congress has passed several laws and commissioned a number of studies; the Administration (last and current) have also commissioned studies; the "think tanks" of the country, like RAND and the Center for Strategy and International Studies, have studied the issue; various panels have examined the subject to provide the government with recommendations. All these groups publish. As mentioned earlier, the review of literature was mostly limited to publications since 1989; the only exception is a review of the legislation passed by the Congress, which begins in 1980. I'll begin with a review of the relevant legislation.

Congressional Efforts to Reduce Barriers Substantial legislative and policy barriers, until recently, prevented any attempt at the pursuit of dual-use technology, or technology transfer in any deliberate, directed sense. For a long time, the order of priority for choosing solutions to military requirements began with military specification-described equipment, and ended, last on the list, with commercially available technology or systems. In recent years, the Congress has attempted to foster greater transfer of technology to the commercial sector,

and to ease use by the military of commercially available products, systems, and technology.

In 1980, as indicated, the Congress began to pass bills intended as enabling legislation for the transfer of federally funded R&D to industrial or commercial use. The first was the University and Small Business Patent Procedure Act of 1980,[6] which allowed universities some control over the license use of patents that resulted from work done on campus and paid for by federal funds. Until that bill, anything developed using government dollars belonged to the government; and the government, in turn, would make the patent licensable to anyone without any exclusivity. No commercial advantage existed, and in some cases new technology lay fallow outside military use because no company would risk the dollars required to develop an application for the technology without patent protection.

The Stevenson-Wydler Technology Innovation Act,[7] which made federal laboratories responsible for setting up specific technology transfer programs to support commercial industry, made even greater strides than PL 96-517. This Act also set up a central source of information on federal laboratories' technology developments and efforts. This law is considered critical to the changeover from indifference or even avoidance of any assistance to industry, to active assistance, at least as provided for in the law. However, not much happened immediately. Longstanding policies against "unfairly aiding" one company in an industry to compete against its peers had a residual effect. Most defense managers were leery, at best, or even hostile to the idea of actively transferring technology to enhance industry competitiveness. In many cases, they did not even know the policy had changed.

In 1982, the Congress tried again, by setting aside a small portion of federal research funds for small business in the Small Business Innovation Development Act,[8] which set up

the Small Business Innovation Research (SBIR) program. This program offers small and medium sized companies financial, managerial, and technical assistance through a three-stage grant process, in which they take a technical concept from feasibility proof, through development, to commercialization. This program works well. Under SBIR, 3,183 grants valued at $460 million were made in FY 1990 alone.[9] Given a start with a successful SBIR program, a small business can use its work to develop commercial products as well as develop products or processes for the government.

Throughout this same period, the Federal Trade Commission, by various clarifications of antitrust provisions in the law, opened the door a bit wider to industrial research consortia. The Congress made it official with the National Cooperative Research Act of 1984 (PL 98-462), and so consortia like SEMATECH began to appear. This government-industry collaborative effort seeks to develop a domestic capacity for world-class levels of semiconductor manufacturing. Its budget of $200 million is contributed to by the federal government ($100M) and the 14 member companies ($100M total).[10] CNN in a special report on 6 Apr 93 stated their assessment that SEMATECH is succeeding.[11]

In 1986, Congress created the cooperative R&D agreement (CRADA) through the Federal Technology Transfer Act.[12] The CRADA makes it possible for federal laboratories to establish agreements with other entities, to cooperatively pursue research which does or may have application both in the federal sector and in the commercial sector. The federal laboratory provides scientists and equipment; the company provides funding and their own scientists and engineers. CRADAs are promising, but in limited application due to the need for technical sophistication in the industrial partners, and considerable administrative

oversight involved. The greatest success to date has been in the biotechnology arena, where the AIDS drug AZT and HIV-antibody tests have resulted from CRADAs.[13]

Presidential Executive Order 12591, signed by President Reagan in 1987, acted to implement the statutory authorities by directing agency heads to assist in transferring technology to the marketplace. It also allowed the institutions that performed federally funded research to claim title to the innovations that resulted. The key in both these laws is that the firms involved hold title to the patents that result. This provides a protected niche for the firm to grow and prepare for competition, with reduced concern about other companies getting rich on its ideas.

In 1989, the National Competitiveness Technology Transfer Act (PL 101-189)[14] further expanded commercial access to federal laboratories, and extended the protection of patents and licenses. One of the complaints listed by companies refusing to do business with the DoD was the insistence by the government that any inventions be freely available to other companies, which meant in many cases the one thing unique about a particular company's product lost its protection, and the company lost its advantage in the commercial marketplace. This and provisions of several other bills passed in this timeframe restored the protections, incentivized invention by both business working for the government and individuals working in federal laboratories, and removed barriers to technology flow between the sectors. PL 101-189 also provided for a cash awards program for federally employed scientists and other technical personnel who had made contributions to the mission of their agency or whose work had commercial application.

The most recent bill passed by Congress is the Defense Conversion, Reinvestment,

and Transition Assistance Act of 1992,[15] which was included in the Defense Authorization Act for 1993. This critical Act substantially reduced the barriers to DoD use of commercially available technology, parts, components, and equipment, explicitly linked national security with "promoting economic growth in high-wage, high-technology industries,..., bolstering the national technology base." and set aside substantial funds to use specifically in meeting the goals and requirements of the Act.[16]

This law also changed the order of priority of sources for consideration by the DoD, to requiring first consideration of the commercially available technology. It sought to reduce the barriers to DoD reliance on the commercial technology and industrial base, and to reduce the reliance of DoD on defense-only industry. Most important, with this act the Congress set aside serious funds for use in dual-use technology efforts ($100 million), for use in commercial-military integration partnerships ($50 million), and for defense regional technology alliances ($100 million). As a result, this Act has gotten the attention of DoD officials -- now, they feel the need to get serious about promulgating implementing policies[17] By eliminating some of the barriers that kept many companies out of the defense business, setting up technology centers, and defining agreements that we might use between DoD and other agencies or commercial endeavors, the Congress has pointed the way. DoD can now employ its R&D dollars in a way that accomplishes both purposes: fostering transfer of technology to the commercial sector, and leveraging scarce R&D dollars to greater effect on systems. Barriers in law still exist, but they are the more generic barriers to doing business with DoD, such as the cost accounting rules, not specific ones that virtually prevent a logical approach. The barriers that remain are in policy, or more precisely, the absence of policy,

for the DoD has not implemented all the provisions of the various laws. Before writing policy, however, the DoD should have a strategy for using the authorities and changes made available to it.

Current studies and reports on dual-use Numerous scholarly papers and books have also appeared on this subject. One of the most thorough treatments of the subject was in the book previously quoted, *Beyond Spinoff*.[18] The authors are convinced that DoD, with its shrinking budget for R&D, "can no longer support a state-of-the-art military by itself. Defense will need to learn to draw on the larger, more dynamic, and increasingly global commercial technology base."[19] *Beyond Spinoff* regards dual-use technology as "a window on the contribution of technology to economic and military security, on the changing relationship between public and private investments in the technology base, and on the nature of the technological process itself."[20] In its policy recommendations, the book recommends dual use as one ingredient of an overall policy thrust it calls technology diffusion -- getting the knowledge into commercial hands.

In 1991, the Center for Strategic & International Studies (CSIS) Steering Committee on Security and Technology published a study examining the barriers between commercial and military sectors. The study, entitled **Integrating Commercial and Military Technologies for National Strength, An Agenda for Change**,[21] concludes that with the exception of a very few protected defense-unique sectors, government will have to link with the commercial sector for R&D. It states that the reasons DoD and the commercial sector cannot get together now results from four areas of regulation:

* accounting requirements and audits
* military specifications & standards

* technical data rights
* unique contract requirements,

Much of the excess baggage on DoD contracts results from trying to meet social goals unrelated to the military requirement the procurement was initiated to satisfy. Fairness to all bidders, elimination of contractor fraud (tax money stewardship), attainment of socioeconomic benefits from defense spending, and cost efficiency are all goals that compete with the requirement to buy the best possible weapon systems for the money. Compliance with the requirement to satisfy these goals creates an enormous burden for the government contractor. The resulting administrative costs take government contractors out of the competitive range attainable by companies not required to meet socioeconomic goals as part of doing business. A report by the Office of Technology Assessment, *Holding the Edge*, reports that

> Analyses by RAND and others imply that the existing regulatory regime imposes additional costs of between 10 and 50 percent on the cost of doing business with the DoD. How much fraud the regulations deter is impossible to estimate, but it must certainly be less than the $15 to $75 billion represented by 10 to 50 percent of the acquisition budget.[22]

The CSIS study also reports a case of a company whose administrative costs for military sales was six times the administrative costs for its commercial sales.[23]

Another outstanding and exhaustive report was prepared by the Panel of the Committee on Science, Engineering, and Public Policy, titled *The Government Role in Civilian Technology: Building a New Alliance*. This panel was drawn from the National Academy of Science, the National Academy of Engineering, and the Institute of Medicine. The panel defined a stage in R&D they call "pre-competitive R&D," which lies between basic research and direct product or process-specific, applied R&D. It is in this stage where "technical knowledge and the scientific base for a potential advance in product or process technologies

is at an early stage of development... ...where there are significant barriers to private sector estimates of commercial market potential."[24] The technical and market risks that exist at this stage, along with the potential national benefits, they argue, suggest that government financial support could properly be considered to have a "public good component." However, the panel believes the value of federal agency direct involvement in pre-commercial research and technology commercialization is very limited. They argue that the direct mission objectives of the agencies will (and should) take precedence over commercialization efforts, and that these efforts "would clearly suffer in a program under the direction of agencies buffeted by political concern"[25] (and by extension, budget concerns). Instead, the panel recommends creation of a Civilian Technology Corporation (CTC), which would operate outside the existing government agency structure, free of civil service rules and constraints, more distant from the political process than the agencies (although never totally free), in order "to encourage cooperative R&D ventures in pre-commercial areas."[26]

In December, 1992, the Defense Conversion Commission released its report, *Adjusting to the Drawdown*, which also treats the subject of dual use. This report strongly recommends integration of commercial and military development and manufacturing. Like all the others, it condemns current procurement regulations and laws, and calls for substantial changes. The details of the changes were to be provided in the appendices, which have not been released.[27]

The five publications cited above represent an enormous body of written material on this subject. As it turns out, most of the relevant literature is used as source by one or more of these major works. Thus such diverse works as Jacques Gansler's *Affording Defense*,[28]

former President Bush's U.S. Technology Policy issued in September 1990,[29] and the Congress' Office of Technology Assessment publication *Building Future Security*[30] all address the same issues, point out the same barriers to collaborative R&D work between industry and government, and make similar recommendations. All are referenced in one or more of the later publications I reviewed above. Therefore, rather than exhaust the literature review and shortchange the issues for consideration, further review of the literature is left to the reader.

In reviewing the literature, however, certain constant themes became apparent. All assess greater integration of commercial and military work, through dual-use or whatever means, to be an appropriate goal with strong positive potential. All found successes and failures -- and all successes, regardless of structure, had strong human commitment and involvement. All the literature reported on the same set of structural barriers; a few picked up on philosophical barriers as well. An examination of the barriers, therefore, seems appropriate.

Barriers to Pursuit of Dual-Use Technology

Many barriers persist despite the work of Congress and others to reduce barriers and foster pursuit of dual-use technology and its related processes. These barriers tend to fall into two categories: philosophical or psychological barriers, which permeate the community from the Administration on down through contracting officers, lab scientists, and engineers; and regulatory barriers, which will require continued attention to eliminate.

The philosophical barriers tend to come from earlier regulations, the mindsets that

attend those regulations, and certain conservative attitudes. At one time, federal contracting agencies were prohibited from actions likely to result in commercial advantage for a particular firm. Much of that has now changed in law, but as a residual consequence, one common objection is that taxpayer money should not be used to improve the competitiveness of private firms. This attitude has changed somewhat, as American firms have inexorably lost ground to blatantly subsidized firms in other nations. One could also argue that improving the competitiveness of American firms compared to international firms is in fact a return on taxpayer's investment in the R&D. This barrier is deep-rooted, however, and will take determination to change. Another objection is that the market should be allowed to make all the adjustments necessary in the industrial base; the market will incentivize commercialization of technology. The evidence, however, clearly shows that the market does not reward for the pre-commercial R&D necessary, often at substantial risk, time commitment, and expense, before a DoD-developed technology is viable in the marketplace.

A third psychological barrier is the attitude of defense R&D managers (and their bosses) that "it's just not in their job jar."[31] Defense R&D managers are extremely busy people who try very hard to do all the jobs assigned to them. If commercialization of the technology developed in their program is desirable, but not required, it will probably be left behind. If it is required, it will be done. Witness the Strategic Defense Initiative Office (SDIO). Lt Gen Abrahamson, its first director, was told by Congress that to continue to receive funding, he would have to ensure the technologies developed there were transferred to the commercial sector. SDIO is a roaring success story of technology commercialization,

where an aggressive attitude toward getting the technology out there made it work. As Nick Montanarelli, SDIO's Deputy Director for Technology Applications, said in his foreword to the 1992 SDIO Technology Applications Report, "the cultural differences between government, industry, and academia inhibit the transfer of technology more than anything else."[32] That same report highlighted over 50 technologies that entered the market place through SDIO sponsorship of the commercialization process. These barriers, more than the barriers extant in regulation and legislation, will submit to leadership and communication, as SDIO's example demonstrates.

More substantial barriers exist in regulatory constraints -- that is, in the way government does business, by comparison with the way commercial firms deal with one another. Such issues as different and difficult accounting standards, audit and inspection requirements, and excessive reporting requirements lead most firms doing business with the government, especially with DoD, to separate their commercial and government business entirely. If they don't, the laws, regulations, and policies frequently require them to report to the same level of detail on their commercial business as they are required to report for their government business. The sheer cost of doing so makes the company uncompetitive against companies without government reporting requirements. Our industry study recently visited Oshkosh Truck Company, a long-time commercial truck builder with big defense business only since the early 1980s. We found the company seriously considering splitting their integrated production line into defense and commercial lines of trucks, to isolate the corrosive effects of government policies from their commercial side. As indicated in the literature review, the Office of Technology Assessment found the costs of doing business

with the government to be 10 to 50 percent higher than with other commercial firms. Vice Admiral Jeremiah, Vice Chairman of the Joint Chiefs of Staff, said in an address on 7 April 1993 that a study he just participated in found the costs to be 30 to 50 percent higher than commercial costs.[33]

Another category of regulatory barriers to effective use of dual-use technology is satisfaction of non-DoD social needs. Congress perceived a need to make government procurements accessible to anyone with a business. In an environment that required purchasing from the lowest bidder, that meant the government often received junk. This caused the DoD to construct specifications and standards that will allow virtually any firm to attempt to "build-to-print." The excruciatingly detailed documents that resulted have ensured we don't get fruitcake without fruit and nuts in it, but the potential to reduce the cost of the fruitcake, and the potential for an unusually good fruitcake have been lost. Overuse of these military specifications and standards is frequently cited as a major barrier to dual-use. Building to spec today is a double-edged sword: on the one hand, the specification may be substantially more rugged or gold-plated than we need; on the other hand, the specifications may actually prevent us from buying state-of-the-art commercially available products. In today's environment, where acquisition managers are increasingly buying according to best value, rather than the lowest price, we can afford and, in fact, must move away from specification and standard-based procurement.

Another example of regulatory barriers is the degree of accountability firms are required to demonstrate for the use of public funds. In the private sector, customers neither require nor even care about the level of detail government requests in such areas as cost and

pricing data, subcontractor management, overhead management, etc. The administrative costs of obtaining such accountability have been shown by some studies to far exceed the amount of fraud captured by the procedures. In fact, the costs are so high that the losses we might incur by eliminating the administrative procedures would be quite acceptable by commercial standards. But, DoD contracting officers and program managers have become increasingly risk-averse, as the nitpicking of the GAO and Congress become more public, more personal, and more likely to result in ruination of reputations even if the individual turns out to be innocent and acting in good faith. Both attitudes and regulatory barriers must be adjusted to overcome this one.

Another major barrier, which may fall in both the philosophical and regulatory bins, is the attitude and restrictions on profits. Through cost and pricing data, negotiated profit arrangements, and fixed price type contracts, the DoD limits the profit ratio to most contractors to the 10 to 12 percent of target cost range. Through restrictions on allowable expenses, audit expenses, and refusal to recognize the real risks of development, the effective profit margin is often much lower, if any profit results at all. The attitude seems to be that the contractors should not get much profit from government coffers anyway. Yet, in the commercial world, companies have told us they consider products with gross profits under 20 percent to be vulnerable to selloff or production cessation.

Can Any Company Actually Do This?

A few firms have succeeded at pursuing commercial applications of technology they either developed under government contract or got access to after the initial breakthrough by

some other company under contract. Most of the firms that have succeeded are second-tier firms. At the first tier are the prime contractors -- usually large firms responsible for integration and assembly of end products or systems, who often manufacture a fairly small percentage of the final product in house. A few primes succeed at dual use. As explained by *Beyond Spinoff,* 'second-tier' refers to firms that supply components, subassemblies, specialty materials, and other items -- including services -- to prime contractors... ...'Third tier' manufacturers produce standardized parts and materials that are priced in competitive commodity markets." The book goes on to describe how it can work:

> Whereas most third-tier firms employ standardized production technology, competing on cost and delivery within well-documented quality standards, second-tier manufacturers often develop strategies around a particular technological specialty that gives them competitive advantage. When they are able to apply their expertise to learn from and solve problems shared by commercial and military clients, these companies form a powerful linkage between the two sectors. [34]

One company used as example of this process is the Lord Corporation, which produces products that reduce vibration and isolate noise in such diverse end items as helicopter rotors, aircraft landing gear, and shock mounts of outboard motors. Defense accounts for only 10 to 20 percent of Lord's business, but its technical requirements are so demanding that Lord's engineers can try new ideas on defense under government risk before commercial products development is ready to take that risk. Lord uses the same teams of engineers and production facilities for defense as it does for commercial, thus ensuring the transfer of expertise from one side to the other. No complex technology transfer or formal dual-use technology program exists here. As Mr. Nick Montanarelli of the Strategic Defense Initiative Office (SDIO) said in an interview, "Technology transfer is a contact sport."[35] The approach taken by the Lord Corporation proves the effectiveness of contact -- or in this

case, dual-use of engineering talent. It also demonstrates a strong, conscious commitment to making dual-use work.

Another firm, Hughes Aircraft Company, took another approach. Hughes strategy, in the communications satellite business, was to seek the common ground between government and commercial customers to the maximum extent possible. Common manufacturing processes were used, and a common bookkeeping system for civil and military projects, DoD procedures for cost and schedule control, contract management, and quality control. They used the standards of the most demanding client, civil or military, to dictate the design of generic components. The overhead cost reductions from commonality benefitted both customer bases. As *Beyond Spinoff* reported, "it is possible for firms to succeed in both military and commercial markets by exploiting the common ground -- in production and technical design -- between these two types of customers, if functional requirements and management practices permit."[36] Again, substantial commitment to the concept was evident.

In a recent review of the combat vehicle industry, of five firms visited, only one planned to try to supplement its defense business with commercial sales of its primary defense product, the High Mobility Military Wheeled Vehicle (HMMWV) or HUMMER sold by AM General. One, Oshkosh Truck, began as a commercial firm, grew almost too fast when it got a big military contract, and has now been rebuilding its commercial base for two years. The others see no possibility for success in commercialization -- and all cite the barriers of excessive accountability and reporting, specialized accounting rules, and over-specification and inspection for government work as their primary reason for expecting

failure. Also mentioned was their complete lack of experience and training in marketing and commercial business practice as reasons for avoiding a foray into commercialization.

From the government side, SDIO reports substantial success in the military-to-commercial flow of technology. For example, through the devices of their Technology Applications Information System (TAIS), demonstration programs, focused articles, speaking services, and others, SDIO claims 65 percent of the firms in their SBIR program reach a technical success, 25 percent find additional money, and 42 percent grow in size. The Diamond Crystal Coating Technology developed to support the SDI space mirror and sensor requirements now provides substantial improvements in commercial optical coating and machine tool technology. Carbon fiber ceramic materials developed for lightweight space structures are now in use in the medical community in lightweight prosthetics and artificial joints. These civil applications of high technology developed for defense use might well have occurred without the SDIO commitment to transferring the technology -- but they might not have, and certainly the time from technological breakthrough to civil application would have been much longer.[37]

III. What Can We Conclude from All This?

The conclusions can be easily drawn. Dual-use technology, in all its forms, can be successful. It can be successful even with the barriers that are still in place in regulations and law today, if leadership attitudes are aggressively proactive and fully committed to making it work. The SDIO experience demonstrates the truth of this statement. The right attitude works in industry, as the Hughes and Lord examples show, as well as in govern-

ment.

Barriers do still exist in the regulations and laws -- barriers that can and should be addressed for good government procurement reasons as well as dual-use reasons. Military specifications and standards were created, originally, for good reasons. For defense-unique applications, they in many cases may still be very necessary. For applications where commercial products can fill or even surpass the requirements, all the literature and experts support doing away with military specifications and standards, and buying best commercial practice instead. Substantial reduction and rationalization of these specs and standards has occurred over the last four to six years, but that work needs to continue.

Cost and pricing data requirements, again as supported by all the literature, are worse than useless in most applications, and generally far in excess of any real requirements. Commercial standards for pricing data, where more than one supplier exists, and market pricing exists, are perfectly adequate for government purposes. Similarly, accounting standards for government procurement are in many cases simply different ways of getting information supplied just as accurately by commercial accounting practices. In other cases, the government accounting requirements exist to report on attainment of the socioeconomic goals of the Congress, rather than any necessity of the procurement. Best commercial practice, again, should be the standard in most cases.

The issue of socioeconomic goals is a more complex one. To the extent that Congress is willing to subordinate effectiveness and industry competitiveness in the global environment to socioeconomic goals, the structure that supports those goals will remain. Within that structure, however, is the flexibility of how to implement the goals in contracting

practice. With creative effort, we have seen that SDIO could both foster technology transfer and meet its socioeconomic goals. With similar energy and creativity, I suggest that the policymakers at all levels in the Administration can meet the goals and improve DoD's procurement effectiveness, accessibility to business, and reduce costs while leveraging technology.

IV. Concerns for Policymakers to Consider

Through all the turmoil of change, whether externally imposed or a consequence of the desire to improve, certain concerns must continue to guide our steps. Regardless of other goals, national security is the mission of DoD -- no degree of turmoil or change can obscure the focus on that mission. Stewardship of the dollars entrusted to us by the taxpayers is another enduring concern. In a rightful push to streamline and become more efficient and accessible, we must ensure we reset the guidelines in a way that provides proper stewardship in balance with efficiency. In addition, a conscious choice must be made between socioeconomic goals and efficiency. Both can be served at some level, but the current level desired is not sustainable with substantially fewer dollars and greater focus on efficiency. The two are contradictory. Finally, the real key, in my opinion, is still leadership and communication. The regulatory barriers must be lowered, the process improved; but in the end, it will be leadership that ensures the attitudes change, the new policies are followed at the lowest levels, and industry actually sees DoD become a quality customer. This can be a "win-win" environment instead of the current adversarial one, but getting there is a function of leadership, and of aggressive communication to ensure the changes get to the lowest operating level. After all, if the contracting officer at the end of the chain doesn't get

the message, then the companies he or she interacts with will see no change in the way DoD does business. Rhetoric just doesn't affect the bottom line.

As President Clinton and Vice President Gore said this year, "Investing in technology is investing in America's future... we must move in a new direction."[38]

V. Recommendations

Only two recommendations clearly arise from this consideration of the subject. First, aggressive pursuit of dual-use technology offers DoD more in future modernization capability than any other foreseeable source. I recommend immediate action to implement the changes the Congress has enacted in law, to enable DoD to stop missing the opportunities now slipping away, and to begin leveraging our increasingly scarce dollars. Secondly, as aggressive action is undertaken, I recommend regular and sober consideration of the concerns raised above. We have an unusual opportunity to truly revamp the acquisition procedures of our government. If we blow it -- if more scandals arise, or ill-considered changes backfire, we will not likely have this opportunity again soon. No panaceas exist, but the creative, thoughtful efforts of the talented people of DoD can have great effect, if well-directed.

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